

**CREW ENGINEERING  
AND SURVEYING**  
5725 KEARNY VILLA ROAD, SUITE D  
SAN DIEGO, CALIFORNIA 92123  
(858) 571-0555

## **Preliminary Drainage Study**

### **Hydrology and Hydraulic Calculations for Olive Hill Group Inc. T.P.M. Application**

#### **Introduction**

The project is located at 270 Palomino Road in Fallbrook. The owner Olive Hill Group proposes to subdivide Parcel 4 of PM 9499 into 4 parcels of 10,000 square feet and a designated remainder parcel of 13,154 square feet. The site currently has a single family residence at the Northern end of the property that will be removed. The site slopes mildly from North to South and drains entirely into storm drains on Stagecoach Lane.

The site has no defined watercourses. The drainage basin conveying water to the storm drains on Stagecoach Lane is less than 5 acres. The developed runoff from and across the site is not concentrated at any point until it reaches the street and drainage facilities. The runoff exiting the site will remain the same following the development of this property.

ENGINEER OF WORK:  
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### **Methodology**

The drainage basin was determined using county topographic maps at 1"=200' scale. A site inspection and survey was conducted to verify the drainage basin and flow patterns.

The Rational Method ( $Q=CIA$ ) was used to calculate the runoff.

Manning's Equation was used for ditch and pipe capacity checks.

Intensity based on 100 year frequency storm.

Equation from nomograph for determining the time of concentration ( $T_c$ ) for natural watersheds :

$$T_c = [11.9 \times L^3 / H]^{3/85} + 10\text{min}$$

Rational Method intensity calculation:

100 Year Frequency: P6 = 3.0" P24 = 5.5" p6 / p24 =55%; so no adjustment required

$$D = T_c, I = 7.44 \times P6 \times D^{-0.645}$$

### Drainage Basin Parameters

Basin	Length(mi)	Height (ft)	Tc (min)	C	I (in/min)	Area (ac)	Q (cu.ft./s)
A	0.20	95.00	14.15	0.54	4.85	4.74	12.41

### Pre-Development vs. Post-Development

	Pre-development	Post-Development
Impervious Area	8956 sq. ft.	22076 sq. ft.
% Impervious	13.5%	33.3%
Runoff Developed Onsite	4.34 cfs	4.87 cfs

Change in Developed Runoff Due to Construction = 0.53 cfs

#### Weighted Runoff Coefficient Calculation

$$C = 0.90 \times (\% \text{ Impervious}) + C_p \times (1 - \% \text{ Impervious})$$

#### Pre-Development

$$C = 0.90 \times (13.5\%) + 0.54 \times (1-13.5\%)$$

$$C = 0.59$$

$$\text{Therefore } Q = 4.34 \text{ cfs}$$

#### Post-Development

$$C = 0.90 \times (33.3\%) + 0.54 \times (1-33.3\%)$$

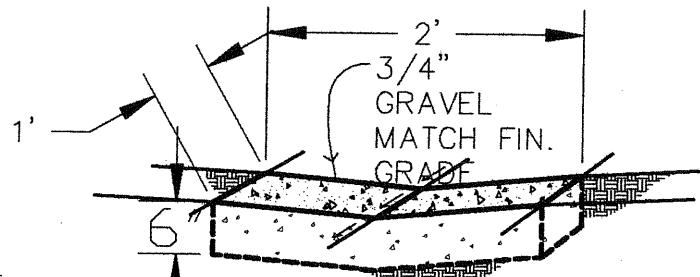
$$C = 0.66$$

$$\text{Therefore } Q = 4.87 \text{ cfs}$$

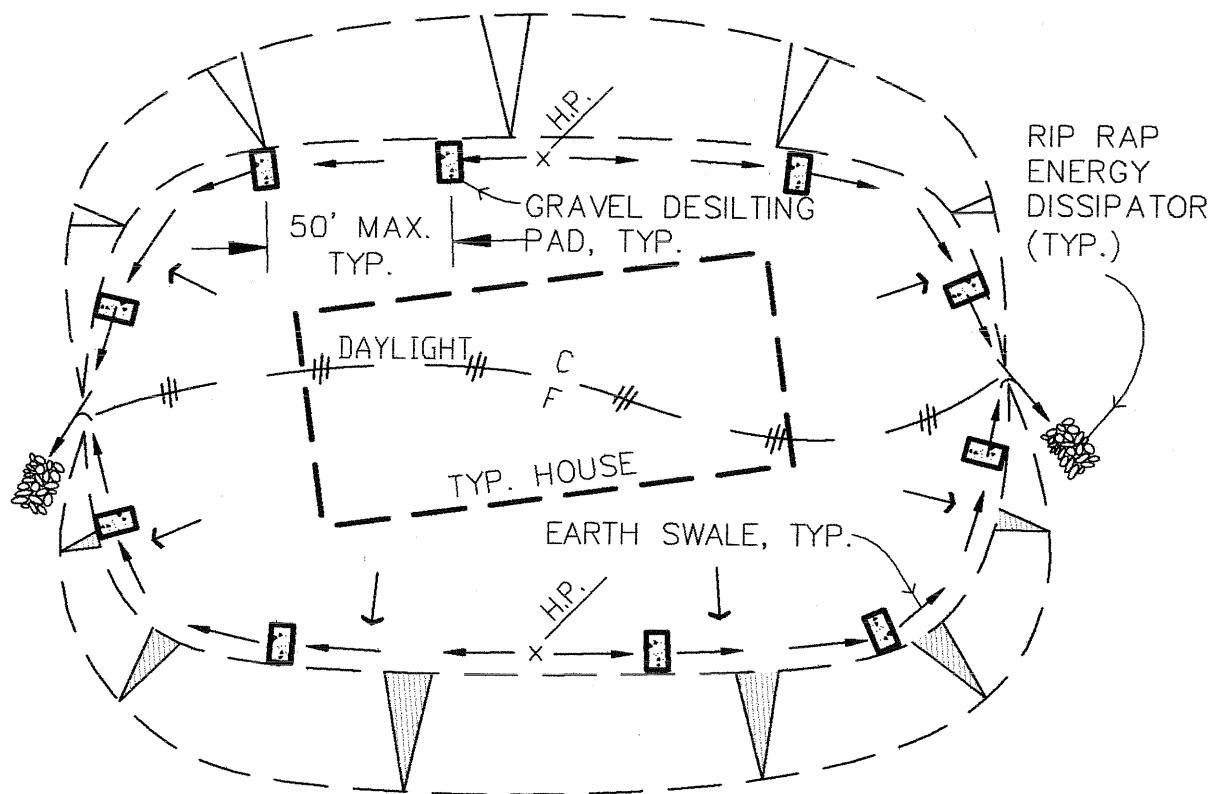
### Conclusion

The estimated developed runoff from the site prior to construction is 4.34 cfs and post-construction runoff is approximately 4.87 cfs. This increase is insignificant and will not result in any substantial erosion due to the energy dissipation devices proposed including rock filters around house pads (see attached detail). The drainage pattern of the site will not significantly change due to the construction of this project.

NOTE:  
INSTALL GRAVEL  
DESILTING PADS  
IN EARTH SWALE  
AT 50' MAX.  
O.C.



DETAIL OF GRAVEL DESILTING PAD



NOTE:  
NO ROOF DRAIN PIPING OFF PAD. ALLOW WATER TO  
OVERLAND FLOW FROM DOWNSPOUT/SPLASHBLOCK  
THROUGH YARD.

TYPICAL PAD DRAINAGE DETAIL

NO SCALE

Circular Channel Analysis & Design  
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: 1282

Comment: PCC DITCH AT PT. A1

Solve For Actual Depth

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0800 ft/ft
Manning's n.....	0.014
Discharge.....	12.41 cfs

Computed Results:

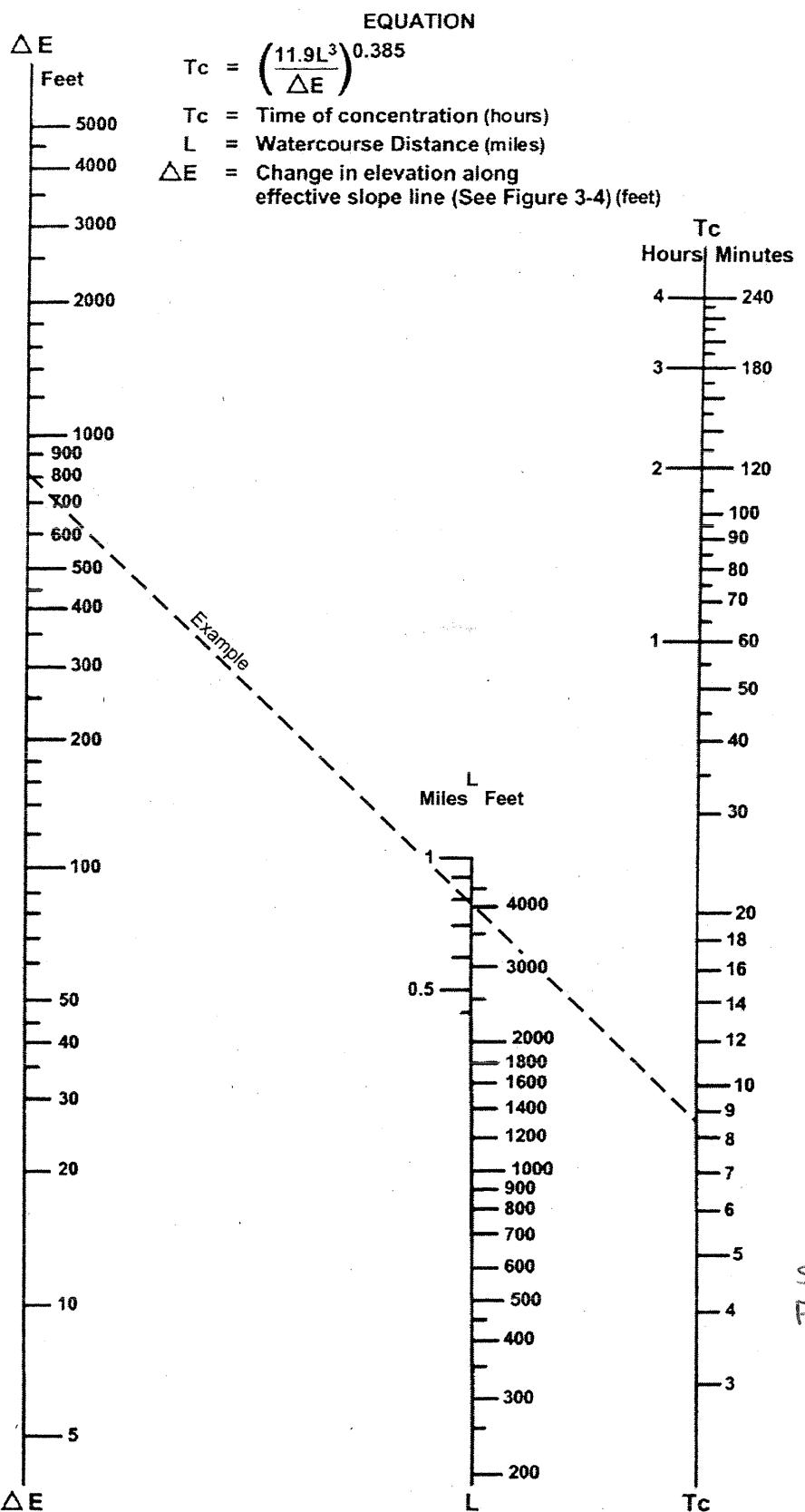
Depth.....	0.62 ft
Velocity.....	14.95 fps
Flow Area.....	0.83 sf
Critical Depth....	1.27 ft
Critical Slope....	0.0066 ft/ft
Percent Full.....	31.02 %
Full Capacity.....	59.42 cfs
QMAX @.94D.....	63.91 cfs
Froude Number.....	3.93 (flow is Supercritical)

**Table 3-1**  
**RUNOFF COEFFICIENTS FOR URBAN AREAS**

NRCS Elements	Land Use	County Elements	Runoff Coefficient "C"			
			% IMPER.	A	B	Soil Type C D
Undisturbed Natural Terrain	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial	General Industrial	95	0.95, <sup>S&gt;</sup>	0.95, <sup>S&gt;</sup>	0.95, <sup>S&gt;</sup>	0.95, <sup>S&gt;</sup>

\*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre  
 NRCS = National Resources Conservation Service



SOURCE: California Division of Highways (1941) and Kirpich (1940)

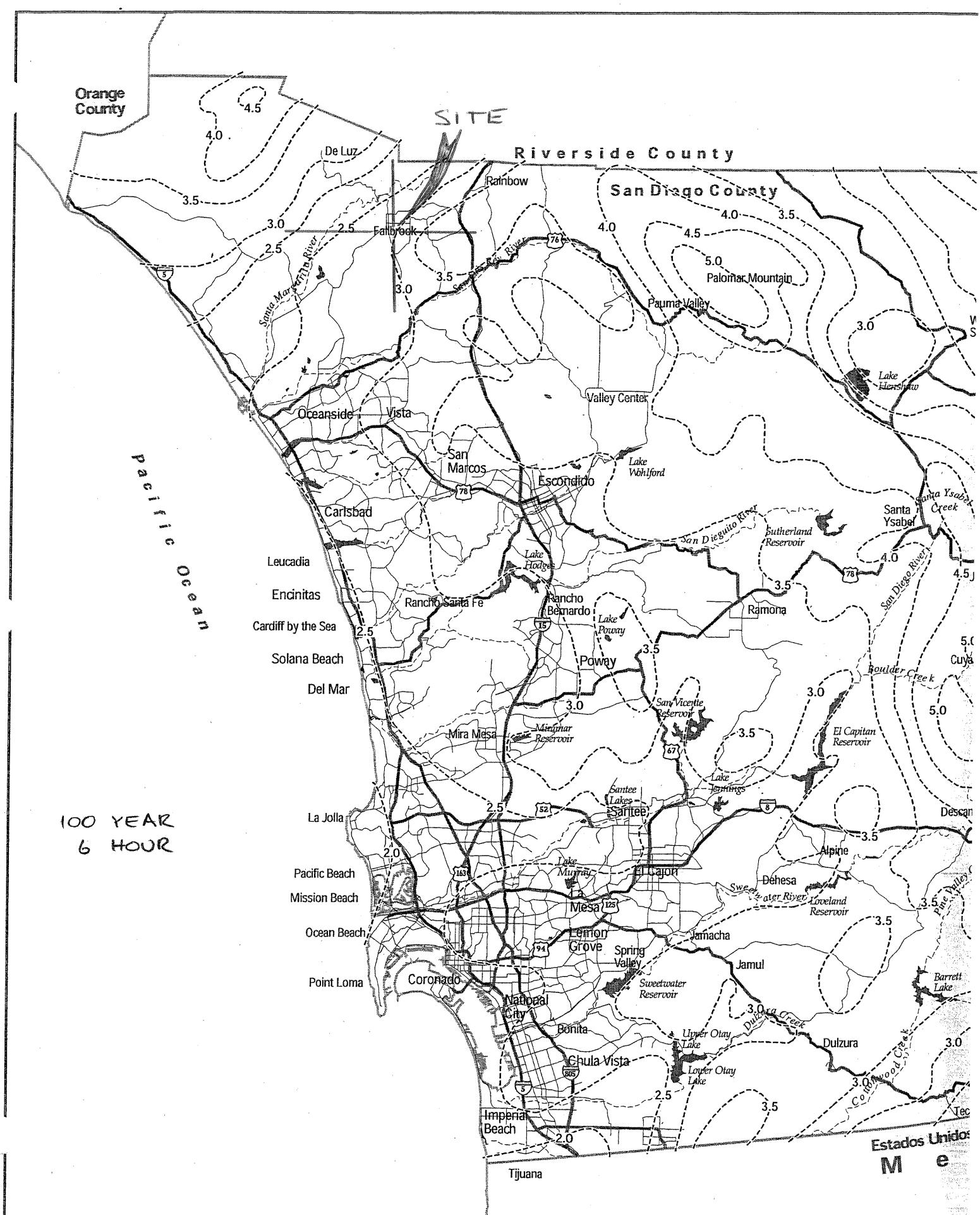
F I G U R E

Nomograph for Determination of  
Time of Concentration ( $T_c$ ) for Natural Watersheds

**3-3**

100 YEAR  
6 HOUR

Pacific Ocean



100 YEAR  
24 HOUR

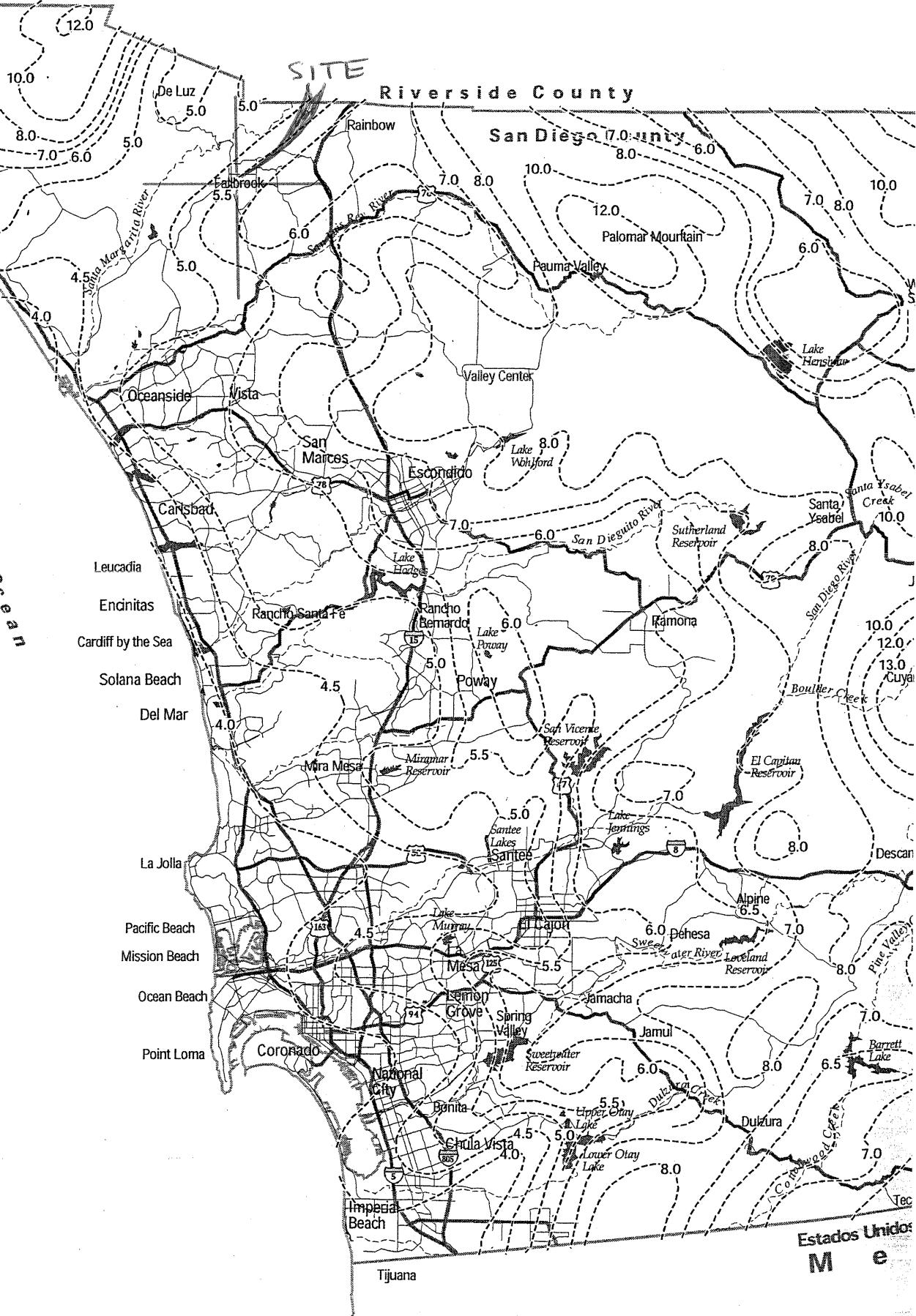
Pacific Ocean

Orange County

SITE

Riverside County

San Diego County



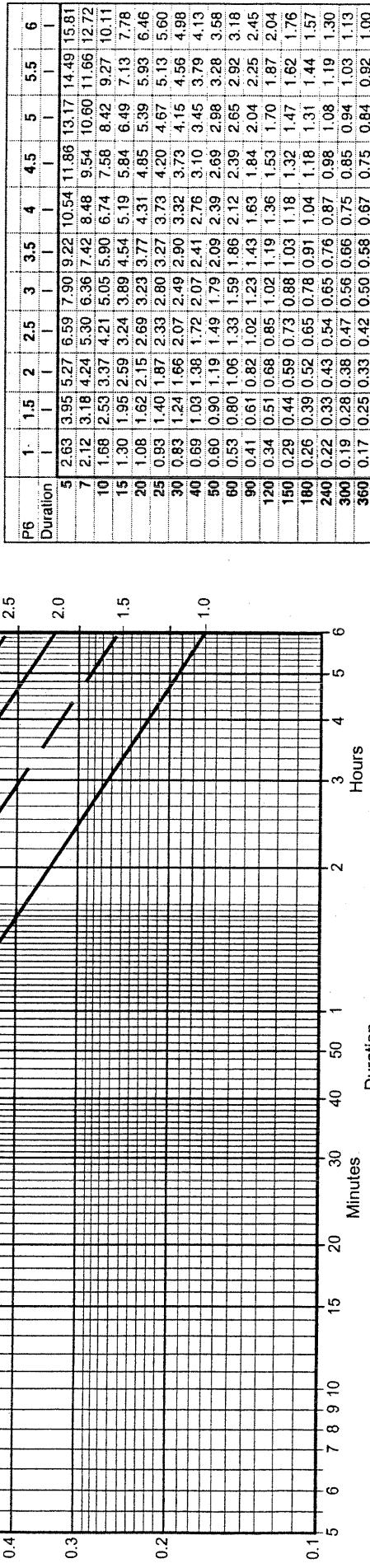
**Directions for Application:**

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

**Application Form:**

- (a) Selected frequency 100 year
- (b)  $P_6 = \underline{3.0}$  in.,  $P_{24} = \underline{5.5}$ ,  $\frac{P_6}{P_{24}} = \underline{55}$  %<sup>(2)</sup>
- (c) Adjusted  $P_6^{(2)} = \underline{3.0}$  in.
- (d)  $I_x = \underline{14.2}$  min.
- (e)  $I = \underline{4.85}$  in./hr.

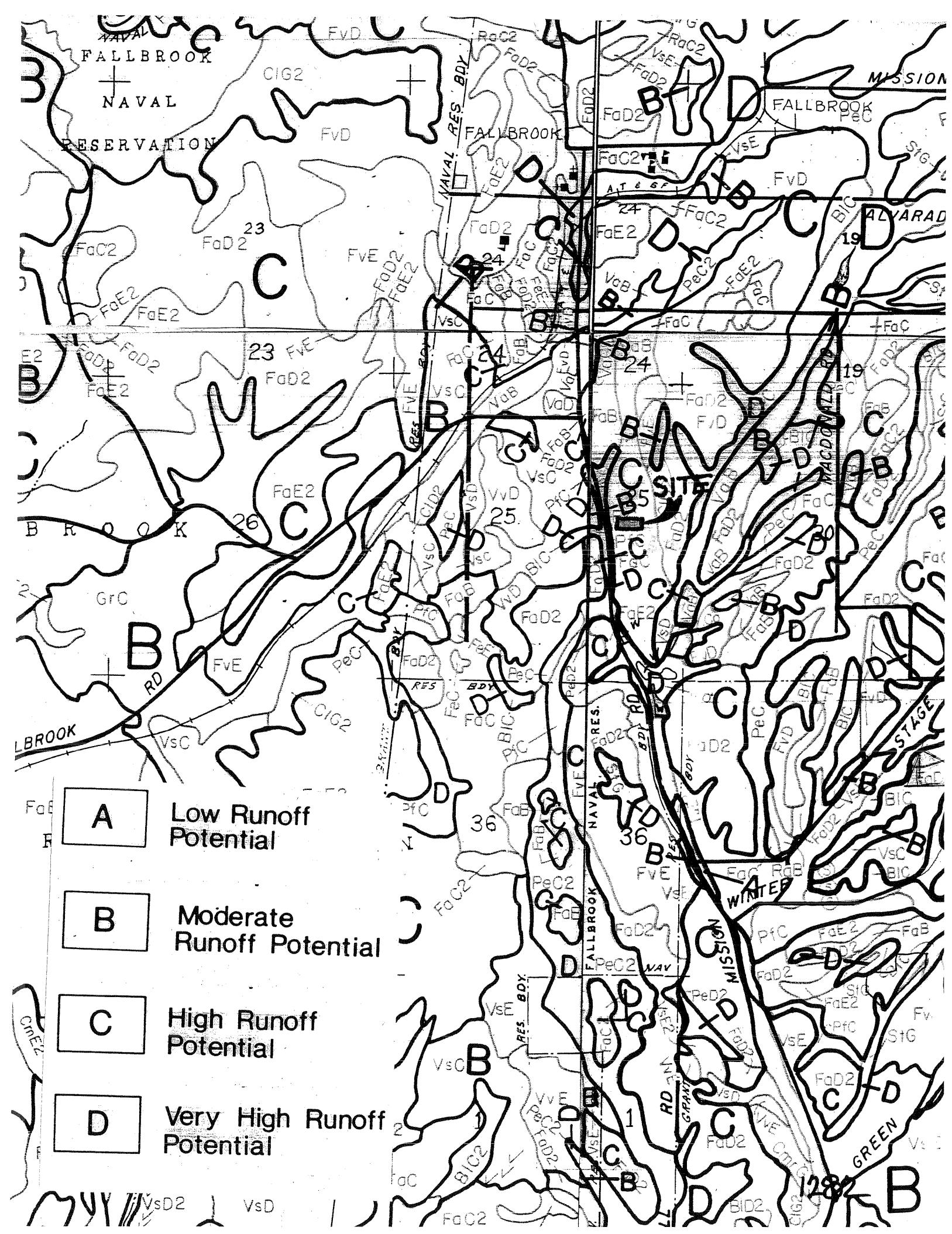
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

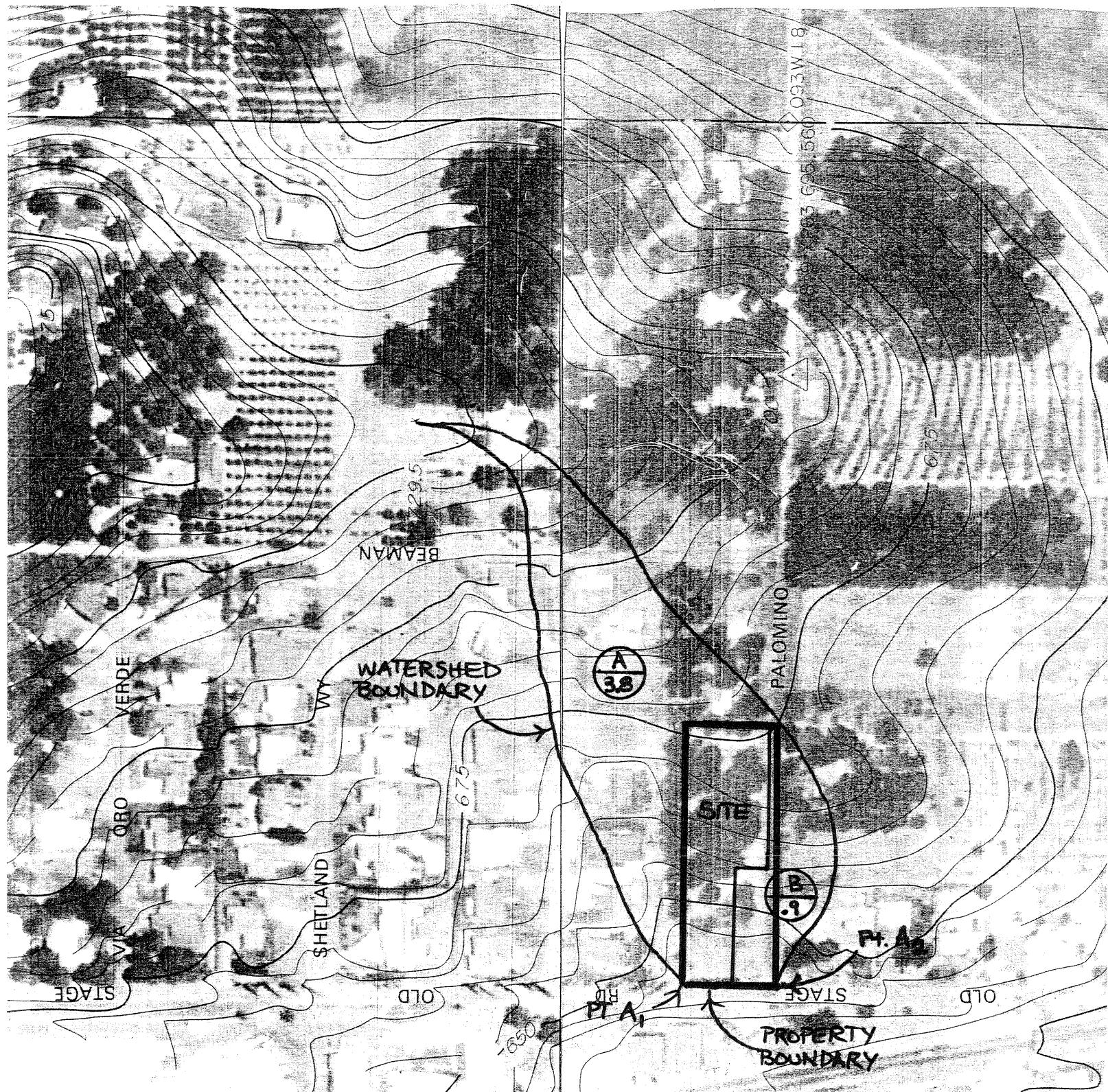


**Intensity-Duration Design Chart - Template**

F I G U R E

**3-1**





Average Values of Roughness Coefficient (Manning's n)

<u>Type of Waterway</u>	<u>Roughness Coefficient (n)</u>
1. Closed Conduits (1)	
Spiral Rib	0.011
Steel (not lined)	0.015
Cast Iron	0.015
Aluminum	.021
Corrugated Metal (not lined)	0.024
Corrugated Metal (2) (smooth asphalt quarterlining)	0.021
Corrugated Metal (2) (smooth asphalt half lining)	0.018
Corrugated Metal (smooth asphalt full lining)	0.018
Concrete RCP	0.012
Clay (sewer)	0.012
Asbestos Cement	0.013
Drain Tile (terra cotta)	0.011
Cast-in-place Pipe	0.015
Reinforced Concrete Box	0.015
PVC	0.014
2. Open Channels (1)	0.009
a. Unlined	
Clay Loam	0.023
Sand	0.020
b. Revetted	
Gravel	0.030
Rock	0.040
Pipe and Wire	0.025
Sacked Concrete	0.025
c. Lined	
Concrete (poured)	0.014
Air Blown Mortar (3)	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018
d. Vegetated (5)	
Grass lined, maintained	.035
Grass and Weeds	.045
Grass lined with concrete low flow channel	.032
3. Pavement and Gutters (1)	
Concrete	0.015
Bituminous (plant-mixed)	0.016

$$R = \frac{A}{W}$$

<u>Type of Waterway</u>	<u>Roughness Coefficient (n)</u>
-------------------------	----------------------------------

4. Depressed Medians (10:1 slopes)(1)

Earth (without growth)	0.040
Earth (with growth)	0.050
Gravel	0.055

5. Natural Streams(4)

a. Minor streams (surface width at flood stage < 100 ft)

- (1) Fairly regular section
  - (a) Some grass and weeds, little or no brush 0.030 ←
  - (b) Dense growth of weeds, depth of flow materially greater than weed height 0.040
  - (c) Some weeds, light brush on banks 0.040
  - (d) Some weeds, heavy brush on banks 0.060
  - (e) For trees within channel with branches submerged at high stage, increase all above values by 0.015
- (2) Irregular section, with pools, slight channel meander
  - Channels (a) to (e) above, increase all values by 0.015
- (3) Mountain streams; no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage
  - (a) Bottom, gravel, cobbles and few boulders 0.050
  - (b) Bottom, cobbles with large boulders 0.060

b. Flood plains (adjacent to natural streams)

- (1) Pasture, no brush
  - (a) Short grass 0.030
  - (b) High grass 0.040
- (2) Cultivated areas
  - (a) No crop 0.040
  - (b) Mature row crops 0.040
  - (c) Mature field crops 0.050
- (3) Heavy weeds, scattered brush 0.050
- (4) Light brush and trees 0.060
- (5) Medium to dense brush 0.090
- (6) Dense willows 0.170
- (7) Cleared land with tree stumps, 100-150 per acre 0.060
- (8) Heavy stand of timber, little undergrowth
  - (a) Flood depth below branches 0.110
  - (b) Flood depth reaches branches 0.140